System of Environmental Economic Accounting

Discussion paper on ecosystem condition

for the Forum of Experts in SEEA Experimental Ecosystem Accounting 2018

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1 Introduction

Healthy ecosystems are the fundamental basis for a resilient society and a sustainable economy. The health of ecosystems can be measured through the concept of ecosystem condition. Ecosystem condition reflects the overall quality of an ecosystem asset in terms of its characteristics (Technical Recommendations).

But how do we know if ecosystems are in a good condition so that they can continue to provide essential ecosystem services in a sustainable way? Addressing this question means establishing a common definition of ecosystem condition, selecting a suitable set of indicators per ecosystem type, evaluating the actual condition of an ecosystem against a reference level and providing an overall, comparable quality score for reporting or accounting. It also requires a further understanding of the relationship between the ecosystem condition and the delivery of ecosystem services as well as detailed knowledge about the pressures (or in a broader sense the drivers of change) that continue to impact ecosystems.

The SEEA EEA technical recommendations do not yet provide definitive advice on how to address these several challenges when reporting ecosystem condition in condition accounts. As part of the revision process of the SEEA EEA TR, this note aims to provide further guidance on ecosystem condition.

In particular, this note builds on the Revision issues note which identifies four research areas and six primary issues for the SEEA EEA Revision.

The revision issues note lists the following main issues for the working group to tackle:

- Register the characteristics that are relevant in the monitoring of condition (what to do with non-ecological characteristics, including land use and management practices) and provide a broad structure for the key or core types of ecological and non-ecological characteristics which should be the focus of measurement in different ecosystem types
- Investigate the types of indicators that would be most relevant for different characteristics
- Develop more definitive advice with respect to reference conditions
- Consider the potential to aggregate across ecosystem assets and ecosystem types
- Link should be made to the measurement of ecosystem capacity, which link ecological condition and provision of ecosystem services.

This note briefly elaborates these issues and proposes a number of possible tasks or actions for the working group. It is important to stress that all the issues which are flagged in this note are open for discussion. Thus this note does not yet contain concrete proposals, recommendations or guidance for ecosystem condition accounts.

2 Characteristics of ecosystem condition

The (above mentioned) definition of ecosystem condition remains relatively vague in what it means with characteristics. Several properties or attributes qualify as characteristics for measuring ecosystem condition such as species occurrence, ecological processes, the structure of ecosystems in terms of their habitats and connectivity or the soil and water quality. The definition of ecosystems condition by

Maes et al. (2018) recognized three different characteristics: Ecosystem condition refers to the physical, chemical and biological condition or quality of an ecosystem at a particular point in time. This definition was also the basis to propose a classification of ecosystem condition indicators, which separated structural from functional indicators and which further recognised the specific role of biodiversity indicators to assess condition. Noss (1990) recognized besides structure and function also composition as category to report indicators for biodiversity monitoring. Further discussion is also needed to understand if it is appropriate to include pressures in an ecosystem condition accounting framework so that pressure indicators can be used to approximate ecosystem condition.

Developing a typology for condition indicators is helpful for several reasons. Just as a classification for ecosystem services, a classification for ecosystem condition is assumed to be helpful to organize different indicators, to compare outcomes across ecosystem types, scales, time, or spatial reporting units and to facilitate aggregation and weighting if a single, aggregated indicator is needed for reporting. A hierarchically designed classification has the additional benefit of allowing the reporting of context and place specific indicators while keeping consistency at a higher classification level.

Several approaches could be envisioned to develop a typology of condition indicators such as an expert based approach or a literature review based collection of indicator followed by an analysis of common characteristics.

Special attention needs to go to a fully covered representation of different terrestrial, freshwater and marine ecosystem types so ensure that relevant pressures and different aspects of these ecosystems are accounted for.

Possible tasks for further elaboration by the working group

- Propose a general typology of characteristics or attributes for ecosystem condition
- Clarify the link between non-ecological characteristics (pressures, drivers of change, ecosystem properties) and ecosystem condition.
- Make proposals for deciding when to use pressure and/or ecosystem condition indicators for accounting (e.g. a decision tree with criteria).

3 Indicators for ecosystem condition

Ecosystem condition is measured using indicators. Several studies and publications have collected and reviewed available ecosystem condition indicators (see also Further reading).

In practice data availability sets an important constraint on the use of indicators to assess ecosystem condition. As a consequence, the condition of marine ecosystem is often measured using pressure indicators; terrestrial ecosystem condition is frequently assessed based on readily available data of land cover and land use (or spatial derivatives); for freshwater ecosystems, more advanced methods to assess ecosystem condition have been developed for instance based on compositional, structural and functional components including species composition of particular taxa.

Possible tasks for further elaboration

- What are requirements to include or exclude indicators from an indicator framework to measure ecosystem condition with the specific purpose of ecosystem accounting

- Reviewing existing indicators or indicator frameworks (although this may be a very time consuming task)
- Proposal for indicators or examples of indicators

4 Reference conditions

The actual ecosystem condition is typically evaluated against a reference condition. Different approaches exist to define a reference. It can simply be a baseline condition (for instance the condition measured at a certain point in time such as the start of a policy which aims to protect ecosystems) or it can be based on measuring the condition of a natural or pristine ecosystem. Historical data can be used as well to define a reference condition. Also statistical approaches (based on a large collection of samples) can be used to set a reference condition (or reference levels for indicators which are used to assess ecosystem condition). The absence of pressures can also deliver valuable information on reference conditions.

Seminal work has been done in this context for rivers and lakes (e.g., different references for water quality and biotic indices based on macro-invertebrates or fish).

There are, however, several obstacles and challenges. What if no reference conditions are available (which is in some areas of the world such as Europe almost always the case); what if a reference condition is meaningless (e.g., in an agroecosystem or an urban ecosystem).

An important question is also if ecosystem condition should be measured considering present land use/management or if it should be expressed against a reference set by potential vegetation (in absence of any human influence). Either of these could be act as a reference, depending on the ecological and socio-economic context, as long as it's made clear which approach has been used.

Possible tasks for further elaboration

- Describe/define per ecosystem type what is a good or a favourable ecosystem condition (e.g., what are the minimum "conditions" / requirements for an ecosystem to be in good condition);
- Distinguish between reference condition and desired condition. Using a reference condition of "natural" does not necessarily imply that one aspires for all ecosystems to be maintained or restored to the natural state.
- Develop advice on defining a reference condition (which methods are available to do so, see also 4th MAES report on urban ecosystems, Maes et al. 2016)
- Develop advice on what to do if no reference condition can be defined (due to lack of data, for social-ecological systems, …), e.g. using statistical approaches based on percentiles.

5 Aggregation

Monetary accounts of ecosystem services have the benefit that they can be aggregated into a total value per ecosystem type which can be used to calculate net present value. This is difficult (or even impossible) for ecosystem condition since there is no single indicator in physical (or monetary) units which provides a complete picture of the health of an ecosystem. Just as a doctor when he examines a person, a set of indicators is required to make an overall assessment of ecosystem condition.

Aggregating these indicators is possible but it results in a qualitative evaluation (e.g., condition is expressed on a categorical scale from poor to excellent) or in a semi-quantitative or dimensionless number (e.g. between 0 and 100).

The aggregation question is also closely related to the reference levels question – they need to be considered jointly. Aggregation is usually proceeded by transformation of indicators (e.g., between a scale from 0 to 1). So the question is if reference levels for indicators can or should be used to scale ecosystem condition indicators.

Possible tasks for further elaboration

- Examples/Lessons learned from existing monitoring or assessment of ecosystem condition (e.g., under the EU water and nature directives or the National Biodiversity Assessment in South Africa, which includes a spatially explicit assessment of ecosystem condition across the terrestrial, inland water and marine realms.)
- Methods for aggregating metrics into a composite indicator
- Proposals for a composite indicator on ecosystem condition (advantages, drawbacks, methods)
- Discuss also possibilities for aggregation spatial (e.g., to compare the condition of a forest with the condition of a wetland)
- Different procedures for aggregating indicators may deliver different outcomes so in how far is it useful or possible to make proposals for a standard procedure

6 Reporting the condition account

The technical recommendations contain a proposal to report ecosystem condition in a table (Table 4.1), focused on recording the value of single or aggregated indicators at two points in time.

An alternative is to report the extent of different ecosystem types (ha or % of the total area) broken down over different condition classes. (e.g. poor, medium and high condition; e.g. Nel and Driver, 2015).

Possible tasks for further elaboration

- Report examples of the two approaches and describe advantages and disadvantages of each approach.

7 The link between ecosystem condition and ecosystem services.

Ecosystem condition and ecosystem services are linked through the concept of **ecosystem capacity** or "the capacity to provide ecosystem services". This capacity is dependent on the extent of ecosystems and their condition but also on other ecosystem properties (e.g., slope, rainfall). Different definitions and interpretations circulate in the literature on accounting (which often relate to the different use of stock and flow terminology). In addition, capacity also refers to the net present value of an ecosystem asset. Note that not only capacity is linking condition to services. Also degradation resulting from overusing services provides a clear link to ecosystem condition.

Possible tasks for further elaboration

- Review definitions of ecosystem capacity (or of capacity used in other disciplines as well); describe the differences; develop a set of options for a definition;
- Propose a conceptual model for ecosystem capacity which clarifies the link between extent, condition, other ecosystem properties and ecosystem capacity, possible based on examples or case studies.

8 Work plan and indicative time frame

The final deliverable is a paper which

- starts from the present version of the technical recommendations of the SEEA EEA;
- makes concrete proposals for guidance on ecosystem condition accounts

Rolling time table (to be updated)

Milestones	**Tasks**
May – June 2018	• Finalizing the composition of the working group • Preparing the forum meeting • Nominations for the wider review group • Collection of literature and case studies on ecosystem condition in an accounting context
18-20 June	Forum of experts • Taking stock of possible activities in member states and international organisations on ecosystem condition • Discussion on the key issues (listed in this paper) and collecting ideas for the paper • Division of tasks (who does what?) + assessment of gaps (do we need additional expertise; do we focus on a few key issues)
01-04 October	London group meeting in Dublin, Ireland • First concept of the paper ready + discussion on the paper
February 2019	• First draft of the paper ready

9 Further reading and citations

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- Final Report: http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-full-report-high-res-40mb
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- https://seea.un.org/sites/seea.un.org/files/lg23_water_provisioning_services_lg-final.pdf
- https://seea.un.org/sites/seea.un.org/files/lg23_review_of_ecosystem_condition_indicators_vardon-harris.pdf
- https://www.researchgate.net/publication/323918886_Review_of_ecosystem_condition_indicators

Forum on Natural Capital Accounting for Better Policy, The Hague, November 2017.

- http://www.wavespartnership.org/en/2nd-forum-natural-capital-accounting-better-policy